

From Tensor to Coupled Matrix/Tensor Decomposition

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Abstract

Decompositions of higher-order tensors are becoming more and more important in signal processing, data analysis, machine learning, scientific computing, optimization and many other fields. A new trend is the study of coupled matrix/tensor decompositions (i.e., decompositions of multiple matrices and/or tensors that are linked in one or several ways). Applications can be found in various fields and include recommender systems, advanced array processing systems, multimodal biomedical data analysis and data completion. We give a short overview and discuss the state-of-the-art in the generalization of results for tensor decompositions to coupled matrix/tensor decompositions. We briefly discuss the remarkable uniqueness properties, which make these decompositions important tools for signal separation. Factor properties (such as orthogonality and triangularity, but also nonnegativity, exponential structure, etc.) may be imposed when useful but are not required for uniqueness per se. Also remarkable, in the exact case the decompositions may under mild conditions be computed using only tools from standard linear algebra. We touch upon the computation of inexact decompositions via numerical optimization. We illustrate some of the ideas using Tensorlab, a Matlab toolbox for tensors and tensor computations that we have recently released, and of which version 2 provides a comprehensive framework for the computation of (possibly constrained) coupled matrix/tensor decompositions.

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